CIGRE Study Committee C1 **CIRED**

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

JWG N° C1/C6.37/CIRED	**Name of CIGRE Convenor:** Juan Carlos Araneda (CHILE) **E-mail address**: juan.araneda@coordinadorelectrico.cl **Name of CIRED and CIGRE SC C6 Co-Convenor:** Fabrizio Pilo **E-mail address**: pilo@diee.unica.it
Strategic Directions #[2]: 1	**Technical Issues #[3]: 1, 7**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[6]: 2, 3, 5	
Title of the Group: Optimal transmission and distribution investment decisions under increasing energy scenario uncertainty	

Scope, deliverables and proposed time schedule of the Group:

Background:

Transmission and distribution investment decisions resulting from a planning process require new approaches to deal with growing uncertainties on many parameters incl. new electricity market frameworks. Among those uncertainties we can mention:

1. High penetration of renewable energy sources (RES)
2. Demand growth (decrease) due to economic uncertainties, including technological development, i.e. electric transportation
3. As a combination of the two previous, distributed energy resources (DER)
4. International interconnections under a market framework
5. Climate change that affects resource operational planning, including hydrology, wind and solar energy, plus the effect of high impact low probability events on weather or natural catastrophes (earthquakes, tsunamis, floods, forest fires, ice storms, hurricanes, etc.)
6. Social and environmental approval of the transmission and distribution projects proposed by planners to meet generation and load expansion.

In recent years, transmission and distribution investment decisions cannot be made alone by power system or market executives because environmental, social and political issues are important factors to be taken into account at the moment the investment is subject to its approval. It has meant long lead times to develop transmission infrastructure (longer than the time required for approving and building a new RES power plant). On the distribution side, populated cities and towns generally imply pushing for the use of underground distribution infrastructure that competes with residential expansion or local requirements.

Significant increase in DER integration, interconnection with other grids, and utilization of SmartGrid technologies makes transmission and distribution system planning more challenging than in the past. Users' measurements and data are available at both TSO and DSO level, including active power exchange measurements, load and generation data and interconnection capability data. Through an appropriate data exchange methodology and IT architecture it should become possible to determine robust plans with efficient resource allocation.

This working group will summarize learnings from several prior SC C1 and C6 WGs which focused on the planning decisions, methodologies and implications derived from the growing

integration of distributed energy resources, such as:

- JWG C1.29 “Planning criteria for future transmission networks in the presence of a greater variability of power exchange with distribution systems” (Brochure 681, March 2017)
- WG C1.22 “Investment decisions in a changing and uncertain environment”
- WG C6.19 “Planning and optimization methods for active distribution systems”

A coordination is required to avoid duplication of efforts considering the recent approval of two new SC C1 WGs:

- WG C1.39 “Optimal power system planning under growing uncertainty”
- WG C1.40 “Planning coordination between system operators, transmitters and distributors: framework, methods and allocation of costs and benefits”

Additionally, it is important to remark that both SC C1 and SC C6 have related preferential subjects for CIGRE Session 47, Paris 2018, namely PS 3 “Coordinated planning between grid operators across all voltage levels” and PS 1 “Achieving flexibility through strategic distribution planning”, respectively.

Scope:

Future energy scenarios are growing in uncertainty due to factors including increasing DER, electrification of transport, interconnection, consumer heating, global emissions targets, etc. This working group investigates how transmission and distribution planning scenarios are consistently used to ensure holistic investment decisions are made by both TSOs and DSOs.

The specific activities of this working group are as follows:

1. Survey and description of recommended methodological practices to build robust, resilient transmission and distribution investment plans, in developed and developing countries. It will include the analysis of current practices on considering and modelling uncertainties, and risk management in generation, transmission, distribution and demand sides.
   - How are potential paradigm shifts in electricity demand taken into account, e.g. in electric vehicle charging, sector coupling for heating, or appliance-specific demand response?
   - To what extent are scenarios used as transmission and distribution planning inputs, consistent with each other and also with other sector planning assumptions as for gas or combined heat and power networks or transport infrastructure. What would be best practice for such consistency?
2. Survey on transmission and distribution planning under uncertainty and distributors’ evaluation of recommendations on planning under uncertainty (e.g. process-driven, standardized solutions that can be implemented quickly once uncertainties resolve themselves).
   - How can optimal transmission and distribution networks which correspond to different scenarios, be reconciled into good short-term investment decisions, as the future evolves? What would be best practice for this?
3. Review the investment decision making processes, for transmission and distribution, in different jurisdictions and how coordination among them is done (if it is done).
   - How are the plans for transmission and for the underlying distribution grids made consistent with each other, especially if the operators are different?

4. Derive joint learnings and recommendations associated to optimal investment decisions under uncertainties – from distribution to transmission and vice versa.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule: June 2017 – June 2019

ToR: May 2017

WG Start: June 2017

Search for WG members: May 2017 (Dublin meeting)

First WG meeting: Q3 2017

Second WG meeting: Q2 2018

Third WG meeting: August 2018 (Paris Session)

WG meeting to revise draft report: Q4 2018

Final report: In 2019

Approval by CIGRE Technical Committee Chairman:

Date: 02/08/2017

Approval by CIRED Technical Committee Chairman :

Date :

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit